Heart Murmurs in Pregnancy: A Phonocardiographic Study of their Development, Progression and Regression*

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ALTHOUGH THE PREVALENCE OF HEART murmurs during pregnancy has been noted frequently, we are unable to find definitive studies recording their incidence or behavior during the course of pregnancy. Reports in the literature indicate that murmurs may occur in 6 to 100 per cent of pregnant women.1,2 Braun et al. described their character as high pitched, early systolic murmurs, predominantly in the frequency range of 100-150 cps, most often heard at the left sternal border.

Lack of information concerning the natural history of these murmurs over the time course of the period of pregnancy may still present the physician with a difficult diagnostic problem in their delineation from organic lesions. This may be particularly perplexing in the light of development of edema and exertional dyspnea with the progress of pregnancy.

The causative relationship of hemodynamic alterations to heart murmurs has also been applied to the pregnant patient. Many investigators have demonstrated a progressive increase in total blood volume beginning early in pregnancy and reaching a peak at approximately 32-36 weeks, with a moderate decline thereafter until term.3,4 Changes in cardiac output follow a similar pattern, but reach a maximum somewhat earlier than blood volume, approximately 28 weeks, falling to normal levels at 38-40 weeks.4,4 Tachycardia, increased blood velocity and hemodilution may also contribute to the presence of murmurs.

This study was undertaken in an attempt to determine the incidence of detectable heart murmurs through the course of pregnancy in a normal population, and further, to define their period of maximal intensity.

METHOD

One-hundred fifty pregnant women were studied from admissions to the Salvation Army White Shield Home for unwed mothers and the Emanuel Hospital Obstetric Clinic, both in Portland, Oregon. Thirty-one dropped from the project before completion. Of the remaining 119, 110 were primagravidae, seven were gravida II, one was gravida IV, and one was gravida V. Their age range was 14 to 42 years, with a median age of 17.5 years, and a mean age of 18 years.

Upon admission to the study, history pertaining to previous pregnancy, rheumatic fever, hypertension, heart murmur, scarlet fever, syphilis, tuberculosis and diabetes mellitus was evaluated. Complete physical examination with particular emphasis on examination of the chest and heart was performed. Chest x-ray film, complete blood count and serologic tests were routinely obtained. In no case was any cardiovascular abnormality found.

Phonocardiograms were taken with the Sanborn twin-beam photographic recorder at a paper speed of 75 mm/sec. Simultaneous lead I or lead II electrocardiograms were obtained. The medium bell, held firmly in place with a chest strap, was the recording microphone. Two tracings were obtained from each of four locations: the second right intercostal space, the second left intercostal space, the fourth left intercostal space and the apex. The first set was taken with the stethoscopic frequency response at a sensitivity setting of 5, and the second with the logarithmic frequency response at a sensitivity setting of 4. Recordings included a minimum of four complete cycles.
of heart sounds taken at end-expiratory apnea. Tracings were done specifically upon admission to either of the clinics (9th to 28th weeks of gestation), approximately the 36th week, during active labor, in the first postpartum week, and in the 6th postpartum week. Multiple, additional tracings were taken from most patients in the two months prior to delivery. Strips were analyzed for the presence of murmurs and extra sounds. Murmurs were described as to location, duration and maximum amplitude.

![Figure 1: Pattern of distribution of total murmurs, maximal murmurs and third heart sounds by five-week interval.](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21453/)  

**TABLE 1—INCIDENCE AND DISTRIBUTION OF TOTAL MURMURS, MAXIMAL MURMURS AND THIRD HEART SOUNDS BY 5-WEEK INTERVAL**

<table>
<thead>
<tr>
<th>5-Week Period</th>
<th>Total Number Pt. - Tracings</th>
<th>Number of Pt. - Tracings with Heart Murmur</th>
<th>%</th>
<th>Number of Pt. - Tracings with Maximal Murmur</th>
<th>%</th>
<th>Number of Pt. - Tracings with Third Sound</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>B/A</td>
<td>C</td>
<td>C/B</td>
<td>D</td>
<td>D/A</td>
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<tr>
<td>6-10</td>
<td>1</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
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<td>1</td>
<td>100.0</td>
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<tr>
<td>11-15</td>
<td>5</td>
<td>2</td>
<td>40.0</td>
<td>0</td>
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<td>2</td>
<td>40.0</td>
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<tr>
<td>16-20</td>
<td>11</td>
<td>10</td>
<td>91.0</td>
<td>2</td>
<td>20.0</td>
<td>8</td>
<td>78.0</td>
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<tr>
<td>21-25</td>
<td>45</td>
<td>38</td>
<td>84.4</td>
<td>20</td>
<td>52.6</td>
<td>30</td>
<td>66.0</td>
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<tr>
<td>26-30</td>
<td>44</td>
<td>32</td>
<td>72.7</td>
<td>13</td>
<td>40.6</td>
<td>25</td>
<td>57.0</td>
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<tr>
<td>31-35</td>
<td>80</td>
<td>54</td>
<td>67.5</td>
<td>11</td>
<td>20.4</td>
<td>23</td>
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<td>36-40</td>
<td>165</td>
<td>115</td>
<td>69.7</td>
<td>24</td>
<td>20.9</td>
<td>33</td>
<td>20.0</td>
</tr>
<tr>
<td>Active labor</td>
<td>32</td>
<td>19</td>
<td>59.4</td>
<td>8</td>
<td>42.1</td>
<td>3</td>
<td>9.0</td>
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<tr>
<td>First week postpart.</td>
<td>117</td>
<td>93</td>
<td>79.5</td>
<td>38</td>
<td>40.9</td>
<td>75</td>
<td>64.0</td>
</tr>
<tr>
<td>Sixth week postpart.</td>
<td>57</td>
<td>33</td>
<td>57.9</td>
<td>4</td>
<td>12.1</td>
<td>20</td>
<td>35.0</td>
</tr>
</tbody>
</table>

**Results**

Of 119 patients completing the project, 111 (93.2 per cent) demonstrated a systolic heart murmur at some time during the course of their pregnancies. Fifty per cent were early-to-mid, 24 per cent mid, and 20 per cent early systolic ejection murmurs, predominately high pitched in nature. They were heard best in the second left intercostal space in approximately two-thirds (65 per cent), in the second right intercostal space in 15 per cent, along the left sternal border in 12 per cent, at the apex in 8 per cent, but frequently were transmitted widely. In addition to a systolic murmur, one patient had a diastolic murmur at the base on one occasion, which was never seen subsequently.

Of the 111 patients with murmurs, only 40 per cent (43) showed a murmur on all series of records taken. In the remaining 68 patients, the murmur appeared and disappeared in an unpredictable and evanescent manner.

The incidence and distribution of total murmurs, maximal murmurs and third heart sounds by five-week interval is illustrated in Table 1 and Fig. 1. The large number of patient-tracings in the 31-40 week group reflects the multiple tracings recorded as patients approached term. Although the range varies from 40 per cent in the 11-15 week period to 91 per cent in the 16-20 week period, these two groups represent very few total tracings, and no
significant preponderance or difference is noted for any given period.

The data were further analyzed for the five-week interval in which the heart murmur was maximal as determined by duration and amplitude in any particular patient (Table 1). There were 120 such maximal murmurs in 111 patients, indicating that in a few instances comparable maximal murmurs were evident at different five-week periods in the same patient. The largest percentage of maximal murmurs occurs in the 21-25 week range, with a steady decline in incidence thereafter toward term. A dramatic increase takes place during active labor and persists into the first week postpartum. The lowest significant level is at six weeks postpartum (Fig. 1).

Third heart sounds were noted in 83 per cent of patients. They were located pre-dominantly at the apex (50 per cent), and at the lower left sternal border (28 per cent). Their distribution throughout pregnancy was similar in incidence and pattern to that of maximal murmurs (Table 1, Fig. 1).

**DISCUSSION**

This study confirms that murmurs are extremely common in the pregnant patient, occurring in about 93 per cent. They are invariably systolic in timing, located predominantly at the second left intercostal space or along the left sternal border, although they may radiate widely. Examination of their pattern by five-week interval discloses that they may occur at any period during pregnancy. They are also apt to be absent in any given patient at some time during the pregnancy, and it was typical in 60 per cent that the murmur would

**FIGURE 2:** Common patterns of heart murmur distribution. P-103. There is a prominent early-to-mid systolic murmur in mid-pregnancy (26 weeks), fading slightly toward term (36 weeks) and reappearing prominently in the first week postpartum. All tracings taken with the medium bell at the second left intercostal space, stethoscopic frequency response, sensitivity 5. ECG lead II. P-46. There is a very slight, early systolic murmur at 22 weeks, emerging at term (40 weeks), which becomes quite prominent in the immediate postpartum period. Once again, the murmur is minor at the sixth week postpartum. All tracings taken with the medium bell at the fourth left intercostal space, stethoscopic frequency response, sensitivity 4. ECG lead II. P-127. Similar pattern of maximum murmur amplitude during the first week postpartum. All tracings taken with the medium bell at the fourth left intercostal space, stethoscopic frequency response, sensitivity 4. ECG lead II.
come and go without any predictable pattern.

One patient demonstrated a diastolic murmur at the pulmonic area on one tracing, in addition to a systolic ejection murmur. It was not seen subsequently. She presented no evidence of organic heart disease and had an uneventful pregnancy. Diastolic murmurs have been generally considered organic, but a recent article reports the occurrence, in two pregnant patients, of a diastolic murmur felt to be functional, and suggests that diastolic murmurs may be more common than previously thought.10

Tabatnik et al11 described the characteristics of the murmurs of extracardiac origin or the so-called mammary souffle. These murmurs occur primarily in the postpartum period, but also, in small percentages, in the second and third trimesters. They are typically systolic, but in many cases have a short diastolic component as well. Because of their high frequency vibrations, they are difficult to record phonocardiographically. Their most important differential features from cardiac murmurs are disappearance with compression of the intercostal space lateral to the stethoscopic bell and their late systolic timing. Careful effort was made to take tracings in such a manner as to avoid recording the mammary souffle.

Figure 3: Various patterns of heart murmur distribution. P-87. There is a moderately prominent early-to-mid systolic murmur at the 22nd and 34th weeks, fading slightly at 39 weeks, and becoming very apparent during active labor. It is essentially absent in the postpartum periods. All tracings taken with the medium bell at the second left intercostal space logarithmic response, sensitivity 4. ECG lead II, except 39th and first week postpartum which are lead I. P-93. A very faint early-to-mid systolic murmur is noted at 20 weeks, which becomes moderately prominent at the 38th and again the sixth week postpartum. All tracings taken with the medium bell at the second left intercostal space, logarithmic response, sensitivity 4. ECG lead II. P-119. A large amplitude murmur is seen at mid-pregnancy (22 weeks) which progressively declines in amplitude during the remaining course of pregnancy. There may be a slight rem minimence at the sixth week postpartum. All tracings taken with the medium bell at the fourth left intercostal space, logarithmic response, sensitivity 4. ECG lead II.
The innocent or functional murmur of pregnancy has been attributed to the marked alterations of hemodynamics which occur during the pregnant course, particularly, increased blood volume, cardiac output and blood velocity. Because of these physiologic factors, one would expect an increasing number and maximal intensity of murmurs with the progress of pregnancy, achieving a maximum during the period 28-36 weeks, with a mild to moderate decline thereafter. This pattern of progression did not evolve in this study. A murmur was as apt to be absent or of lesser magnitude during this period of expected peak occurrence as not (Fig. 2 and 3). Indeed, maximum intensity of murmurs in any given patient was most often in mid-pregnancy (15-25 weeks), then declining steadily in percentage incidence toward term (Fig. 1). A surge in intensity and incidence during active labor and in the immediate postpartum period was characteristic (Fig. 2).

There is no evidence that the heart murmurs recorded in these patients are secondary to organic heart disease. In all probability, they are related to alterations of blood flow through normal valves. Certainly, physiologic circulatory changes are influential, as may be altered configurations of the chest (flat-chest, kyphoscoliosis and pectus excavatum). The puzzling variations of incidence and intensity may be the result of relative positional changes of the heart and valve areas caused by progressive distortion of the diaphragm and torsion of the heart on its pedicle during the evolution of pregnancy.

**Summary**

Heart murmurs are extremely common in the pregnant patient, occurring in approximately 93 per cent. No specific pattern of distribution by five-week interval could be determined. It was characteristic in 60 per cent of patients that the murmur would appear and disappear at unpredictable intervals. The largest percentage of maximal murmurs is noted in mid-pregnancy (15-25 weeks), showing a gradual but definite decline thereafter to term, with a resurgence in numbers and intensity during active labor and in the immediate postpartum period. This discrepancy of expected correlation of murmur frequency and magnitude with known physiologic circulatory alterations of pregnancy is enigmatic. Possible contributing factors are briefly discussed.

Third heart sounds are also very common, occurring in 83 per cent of patients, in a pattern of distribution similar to that of maximal murmurs.

Patients followed through the six-week postpartum period showed a marked decrease in incidence of heart murmurs.

**Resumen**

Los soplos cardíacos son extraordinariamente frecuentes en la mujer embarazada, ocurriendo aproximadamente en el 93 por ciento. No se ha podido determinar modalidad alguna de distribución regular por periodos de cinco semanas. En el 60 por ciento de los casos el soplo aparecía e desaparecía característicamente, a intervalos imprevisibles. El mayor porcentaje de soplos de intensidad máxima fueron observados entre las semanas 15a. y 25a., mostrando posteriormente un emisor más, gradual pero bien definido, hasta el final del embarazo, con una resurgencia en incidencia e intensidad durante el parto y en el postparto inmediato. La discrepancia en la correlación entre la frecuencia e intensidad del soplo y los cambios circulatorios fisiológicos bien conocidos del embarazo, es un enigma. Se analizan someramente los posibles factores coadyuvantes.

El tercer ruido cardíaco es también frecuente, ocurriendo en el 83 por ciento de los pacientes, con una modalidad de distribución similar a la de la intensidad máxima del soplo.

Las pacientes observadas durante seis semanas después del parto mostraron una disminución marcada en la incidencia de soplos cardíacos.

**Résumé**

Des souffles cardiaques sont très fréquents chez la femme enceinte, se produisant approximativement dans 93 pour cent des cas. Aucun mode particulier de distribution, par période de cinq semaines, n'a pu être déterminé. Il est frappant que chez 60 pour cent des patients, le souffle apparaîse et disparaisse à des intervalles imprévus. Le plus grand pourcentage des souffles au maximum est noté au milieu de la grossesse (15ème à 25ème semaines), montrant une diminution progressive mais nette à partir de ce moment jusqu'au terme, avec une réapparition en nombre et en intensité durant le travail et la période.
immediatly partum. Il est difficile d'expliquer le désaccord entre la fréquence et l'intensité des souffles que l'on attendrait, et les altérations physiologiques circulatoires de la grossesse. On discute rapidement d'autres facteurs pouvant éventuellement contribuer à ces faits.

Les troisimes bruits du coeur sont également très fréquents, survenant chez 83% des patientes, avec un mode de distribution semblable à celui des gros souffles. Les patientes suivies pendant les six semaines du post-partum montrent une diminution nette dans la fréquence des souffles cardiaques.

**ZUSAMMENFASSUNG**


Dritte Herzgeräusche sind ebenfalls sehr häufig und kommen in 83% der Patienten vor mit einer Verteilungshäufigkeit ähnlich derjenigen der maximalen Geräusche. Über 6 Wochen in der Periode post partum weiter verfolgte Patienten zeigten eine ausgeprägte Abnahme in der Häufigkeit der Herzgeräusche.

**REFERENCES**


For reprints, please write: Dr. Uhland, 2278 Lloyd Center, Portland, Oregon 97232.

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**H. INFLUENZAE AS A CAUSE OF ADULT PNEUMONIA**

The significance of *Haemophilus influenzae* as a cause of adult pneumonia is unclear. A 20-month prospective study at a large city hospital found six adults with bacteriologically proved cases of pneumonia due to *H. influenzae*. These patients had clinical and radiologic evidence of pneumonia, and *H. influenzae* in their blood and sputa. Diabetes mellitus, hematopoietic malignancy, and alcoholism, diseases that are believed to increase susceptibility to infection by *H. influenzae*, were not a prominent feature in these patients. No clinical signs or symptoms were noted that would distinguish this form of pneumonia from that due to other causes.